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Some Physical Tests of Value to the Glass Man

By D. E. SHARP and J. BAILEY *

A COMMON problem in plants making a variety of glasses is how to tell whether or not a certain piece of glass is of one kind or another. For example, a plant may be manufacturing salad plates from three kinds of crystal glass, a soda-lime glass, a medium-lead glass and a high-barium glass. The sales manager has a complaint from a customer, and the laboratory is asked to tell the type of glass of which the plate is made.

In this case, it might be easy to differentiate between soda-lime and the other two types of glass because of the relative lack of brilliance of the former, or its lightness. But the lower the lead content of the flint glass, the harder it is to distinguish it from the others. This type of problem is frequently met with in various forms and there are a number of simple rapid tests that can be used to distinguish quite positively between various glasses, without resorting to chemical analysis. These tests depend in general on certain physical properties of the glasses, and most of them take but a minute or two to perform. The tests are not only useful for determining whether two samples of glass are of one and the same composition, but they may be used in conjunction with a set of standards for determining the type of glass of which the sample under test is composed.

These tests fall into two groups—those which depend upon the comparative behavior of the sample when used in connection with a specimen of a standard glass, and those which require the determination of some actual physical constant. In most instances the comparative tests, only, will be sufficient to identify the unknown glass. However, both groups will be described here, since the more accurate tests are sometimes a valuable confirmation or even a necessity.

In all cases where one or several types of glass are being constantly manufactured, it is advisable to obtain a stock of glass samples from a satisfactory melt of each kind of glass. These samples should be carefully preserved and used as standards of comparison at all future times when tests are being conducted. Glass in the form of rod and in sizes ¼ inch to ½ inch diameter and three or four feet long is usually best for this purpose. Rod is easily made, can conveniently be stored, and is readily cut into suitable test pieces.

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Expansion Test

Relatively small changes in composition are readily detected by the change in coefficient of expansion which they produce in glass. The test for expansion[1] is one of the easiest to perform although sometimes a little experience is necessary to properly interpret the result obtained. The only tools necessary are a good, medium-sized blast lamp and a pair of pincers, or better still, a pair of laboratory forceps. The glass to be tested is worked into the form of a rod of the approximate size of the standard rod, say ¼ inch in diameter and an inch or so in length. This piece is kept hot while a piece of standard cane of any convenient length is heated at one end. The two pieces are then placed side by side and fused in the flame. See Fig. 1. When both have become soft they are pressed together with the forceps so as to form a composite piece of glass of slightly less than the original thickness of either glass. See Fig. 2. The extreme end of this composite section is then grasped with the forceps and the pressed section heated in the burner until it is uniformly hot for perhaps ½ inch of length. During this time the glass is being held at both ends and care must be taken that the softened portion is not twisted. The glass is now removed from the flame and quickly drawn out into a fairly thin thread. A slight tension is maintained upon the thread until it has cooled. The end held in the forceps is then lowered until the thread is in a nearly vertical position, meanwhile being supported from the standard cane held in the other hand, and the lower end is broken off about a third of the way from the bottom.

[1] Donald E. Sharp, J. Am. Ceram. Soc. 4, 219-23 (1921).

The thread is composed of two kinds of glass; one side is of the standard glass and the other of the glass under test. If there is any difference in the coefficients of expansion of these two glasses the thread will assume a curved shape instead of hanging vertically. The glass having the *higher* coefficient of expansion will be on the *inside* of the curve. This test is accurate to about two units in the seventh decimal for glasses of the same general type, and is therefore a very delicate test.

In addition to furnishing a method of distinguishing between different glasses this expansion test may be used to

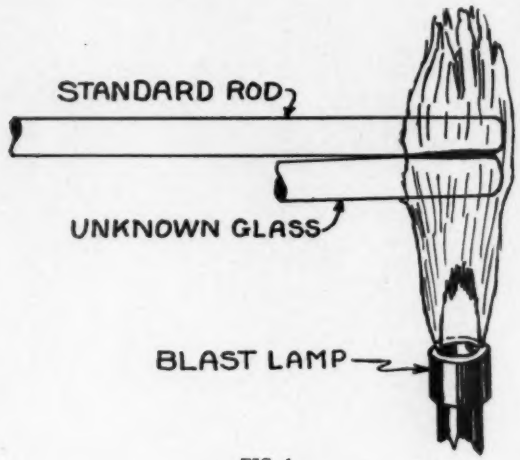

FIG. 1

determine whether two glasses will seal together or whether one will be suitable for casing or flashing the other.

Samples for test must often be obtained from some irregular shaped piece of glass such as a dish or drinking glass. Such an irregular piece of glass may be worked over into rod form in the following manner:

Select a suitable piece of glass. Heat one sharp corner and seal it to the piece of cane of convenient length. When this has cooled enough to be rigid seal the opposite end of the test piece to another cane. The specimen is now held between the two pieces of cane and can be conveniently manipulated in the flame.

Carefully heat the specimen as uniformly as possible and at the same time exert a slight twisting movement on it.

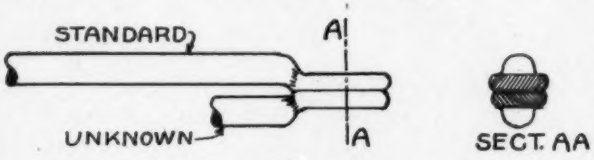

FIG. 2

As it softens, it will form itself into a helix and continued twisting with a slight endwise compression will gradually form it into a ball. Further heating and manipulation gradually smooths out the surface wrinkles. The whole is now removed from the flame and a slow drawing-out suffices to shape the specimen into a fairly presentable piece of rod for use in either the expansion test or workability test which follows.

Workability

For some purposes glasses should have approximately the same working properties. A test for softness or range of workability of these glasses gives valuable information and often will serve also for distinguishing between glasses.

The glass to be tested for softness is first worked into a rod about ¼ inch diameter and one inch long. This rod is then joined at one end to a longer piece of rod for easy handling and the free end is heated. A piece of the standard cane is held in the other hand and is also heated on one end. When the two glasses are sufficiently softened the rods are joined together as in a butt weld. The junction is heated uniformly, and the composite rod removed from the flame, turning all the while, and a slow steady pull exerted on each end. If the two glasses are of equal softness, the glass will draw out evenly on each side of the junction. If one glass is softer than the other, it will pull out more rapidly and become thinner in diameter than the harder rod. With a little practice quite small difference in softness in the working range may be determined.

Rapid Test for Specific Gravity

Another simple method of distinguishing between two different glasses is by testing them for a difference in specific gravity. If the glasses are not too heavy the test may be made by a flotation method using heavy liquids. One such liquid is bromoform, which has a specific gravity of about 2.884. Ordinary soda-lime glass will float on this liquid like a cork on water. Thus to distinguish, for example, between soda-lime glass with a density of 2.49 and a borosilicate with a density of 2.46, the bromoform must be diluted by some lighter substance. Acetone is a satisfactory material. A test tube may be conveniently used for the test, and specimens of glass need not be any larger than a BB shot. The two test pieces are dropped into the tube, and enough bromoform poured in to cover them. Acetone is then added, drop by drop, and care taken to insure thorough mixing. In the case of two glasses mentioned above, a point is soon reached where the borosilicate floats to the top because it is lower in density than the soda-lime glass. By keeping suitable standard pieces of glass on hand, as well as a little of the liquid of about the right density such a test can be conducted in a very few minutes.

There are other simple tests which can be made with but little apparatus. For example, if a piece of lead-glass is heated in the reducing flame of a blast lamp the surface of the glass will turn black, because of the reduction of the lead oxide in the glass to metallic lead. This test may often be used for quickly distinguishing a lead-glass from a barium glass of the same specific gravity. Although antimony in glass gives a darkened surface in this test, it is seldom present in sufficient quantity, except in telescope flint glass, to cause any confusion.

Frequently, too, a good deal can be told about a glass from the way it acts under a diamond or steel-wheel cutter. Borosilicate glass, for example, requires a good deal of pressure and acts brittle when cut. Soda-lime glass generally cuts quite easily. When employing such a test one should always first examine the glass in a polariscope for

strain, as more pressure is required to cut a strained sheet of glass, than an annealed piece.

The second group of tests calls for more apparatus than the simple tests given above. But at least one of the tests, that of measuring the specific gravity, does not require anything but equipment to be found in any laboratory, namely, a chemical balance, a beaker, some distilled water, a piece of fine wire and a thermometer.

Specific Gravity

The sample of glass is weighed in air and is then suspended in distilled water by means of a fine wire and the weight again determined. The glass is then removed from the wire, and the weight of the wire while still suspended in the water is determined. The specific gravity is found by the equation:

$$\text{Specific gravity} = \frac{A}{A - W + K}$$

Where A is weight of the glass sample in air, W is the weight of the glass suspended on the wire in the water, and K is the weight of the wire only, in water. For accurate

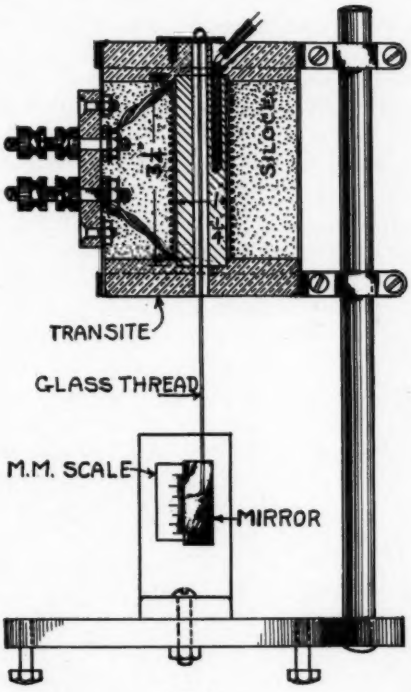

FIG. 3

work it is necessary to use distilled water which has been freed from dissolved gases, and to correct for the change in volume of water with temperature.

The corrections are applied to the denominator of the equation given above, which is really the weight of the displaced water. The correction factor for any temperature ordinarily encountered may be found from Table 1, either directly or by interpolation. More accurate figures can be obtained from any of the usual hand-books of physical constants such as the Smithsonian Physical Tables.

TABLE I

Centigrade Temperature	Factor
16°	1.0010
18°	1.0014
20°	1.0018
22°	1.0022
24°	1.0027

(The correction factor is the volume of water at the temperature of measurement when the mass of a cubic centimeter of water at 4° C. is taken as unity.)

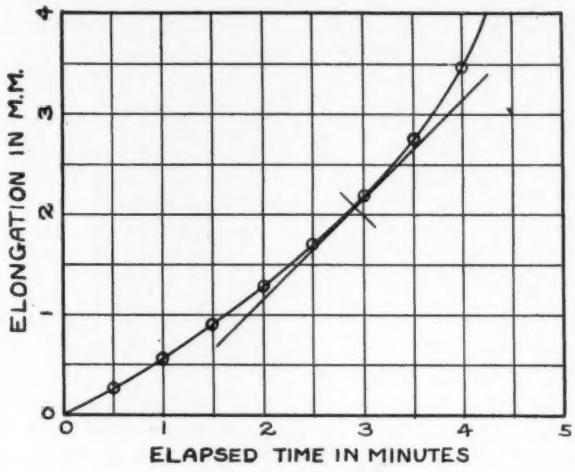

FIG. 4

As an example, suppose the following data had been obtained.

Weight of glass in air	6.330 grams
Weight of glass and wire in water	3.835 grams
Weight of wire only in water	0.065 grams
Temperature of water	17° C

The weight of the displaced water is 6.330 minus 3.835 plus 0.065 which equals 2.560 grams. Multiplying this by the factor of 17° centigrade (1.0012 from Table 1) gives 2.563 as the corrected volume of the displaced water. The specific gravity is found by dividing 6.330 by 2.563 or

$$\frac{6.330}{2.563} = 2.470 \text{ (specific gravity)}$$

Softness Test

An accurate test of the softness of the glass, but one that generally requires more glass then the method previously described, as well as fairly good samples, may be made by the method described by Littleton[3]. For this test a rod of glass is required that is about one millimeter in diameter, of fairly uniform cross section and about nine inches in length.

Experience has shown that the results obtained by this method are somewhat dependent upon the characteristics of the furnace used, and the results obtained in one furnace will differ from those when another is used unless the furnaces are of precise manufacture and identical in temperature distribution. This is not serious for purposes of

[3] J. T. Littleton, Jr., Jour. Am. Ceram. Soc., 10, 259-64 (1927).

comparison because results may be duplicated with reasonable accuracy in any one furnace.

A conventional type of such a furnace is shown in Fig. 3. Essentially, it consists of a cast iron core with a relatively small hole running through its axis. Another hole is provided for the thermo-element for measurement of temperatures. The core is insulated with mica and wound with nicrome resistance wire. Heavy transite pieces for furnace ends are fitted on, and the whole is surrounded by a metal shell. The space is filled with sil-o-cel powder for heat insulation. A suitable stand holds the furnace rigidly and provides means for leveling. A mirror and scale are provided for reading the position of the end of the test piece.

The test piece is made up by drawing out a heated section of the glass to be tested. This glass must first have been worked into the form of a rod or elongated ball shaped section between two pieces of cane. It is essential that the hot portion be circular in cross-section and uniformly heated. When in the proper condition it is removed from the flame and drawn out into a thread approximately one millimeter in diameter. The tension is maintained until the thread hardens completely, and the diameter at various points is measured with a micrometer. A section about 10 inches long, having very nearly the same cross-sectional area throughout, is cut out of the thread for use as a test specimen. One end of this is heated in a flame to form a ball about ⅛ inch in diameter. At a point 9 inches below this ball, the thread is heated and a small fine point drawn-out as shown in Fig. (3).

The specimen is then run through a special collar and suspended in the furnace with the pointed-end down, and is rotated until this end points toward the scale. The furnace is leveled so that the specimen hangs through the center of the furnace without coming into contact with any part of the furnace wall. During the test, drafts of air must be avoided.

The current supply to the furnace is regulated so that the temperature rises at the approximate rate of 5° per minute. When the temperature gets high enough the glass will commence to soften and will elongate under the force of its own weight. The elongation will be noted by movement of the point on the scale and regular readings of temperature and the scale reading in millimeters are taken at intervals of one minute. The rate of elongation will, of course, increase as the temperature rises.

An inspection of the data will locate the approximate point at which the elongation is at the rate of one millimeter per minute. The exact point is found by plotting the elongation against time as in Fig. (4). The tangent drawn to this curve and having the slope of one millimeter per minute locates the desired point on the curve quite accurately. The temperature may then be ascertained from interpolation of the data. Littleton defines the softening point as the temperature at which the rod elongates at a rate of one millimeter per minute under the conditions described above.

This test is sufficiently accurate to be used as a routine control test to detect changes in physical characteristics such as often occur due to lack of uniformity of batch ingredients. A more thorough test may be made by determining the softening temperatures when the glass samples are loaded with different weights, and plotting a curve of the temperatures so found, against the load per unit area. Such a curve of the mobility of glass is quite accurately reproducible from various samples of glass of identical composition, and serves well to distinguish between glasses of similar characteristics which differ slightly in composition and mobility.

Refractive Index

The refractive index of a very small sample of glass may easily be found by the use of a low power microscope, and a set of liquids of known refractive index. The glass is crushed and some of the grains are placed on the microscope slide. These are covered with a drop of one of the liquids. The microscope mirror is swung so as to give oblique illumination from one side. The microscope is now focused. Due to the difference between the refractive indices of the liquid and the glass, one side of the grain will be brighter and the other side will have a dark shadow. If the dark shadow appears through the eyepiece to be on the same side as that from which the light is coming the index of refraction is lower than that of the liquid and vice-versa. Another liquid is then tried, and after a few attempts the one having the same refractive index as the glass is found. When this is the case the grains will have almost disappeared and no pronounced change will take place when the focus is changed or when the mirror is moved.

A very large assortment of chemicals covering the refractive index range of all ordinary glasses is available. The index of refraction of these chemicals is accurately known and can be found in the chemical handbooks. Sets of liquids for this purpose can also be purchased from dealers in petrographic microscopes.

When the instrument is available, and means are at hand for preparing the specimens, an Abbe refractometer provides an excellent way of distinguishing between slightly different glasses. Specimens for use with this instrument should be homogeneous, well polished on one flat surface and should have one end polished so that a fairly sharp edge is formed at right angles to the flat surface. A specimen as small as ⅛ inch wide by ¼ inch long can be used for the measurement if carefully prepared, although it is recommended that pieces about ⅜ inch wide, ¾ inch long and ⅛ inch or more in thickness be used when possible.

There is a logical sequence in which such a series of tests may be made. Let us take the case of the three salad plates as an example and assume that they have just been brought to the laboratory for examination and identification. The plates are labeled with numbers 1, 2, and 3. The procedure and method of recording would be something like the following:

REPORT OF TESTS ON THREE SALAD PLATES OF CRYSTAL GLASS MARKED NO. 1, 2 AND 3, JANUARY 26, 1931

1—Sample No. 1, appeared to be less brilliant than the other two and seemed lighter in weight.

2—The three plates were cut with a steel-wheel cutter in such a manner as to provide small strips of glass for tests

in the blow-pipe. Samples No. 1 and 2 cut fairly easily, No. 3 cut rather hard. None of the glasses showed strain in the polariscope before the test.

3—A small sample of each glass was heated in the reducing flame of the blast lamp. No. 1 was fairly soft and devitrified a little on the surface. No. 2 was also soft and turned a decided black on the surface. No. 3 remained brilliant and clear when heated, was medium soft and had a somewhat watery appearance when quite hot, which is characteristic of borosilicate or barium glasses.

PRELIMINARY CONCLUSIONS:

Glass No. 2 is a lead glass (blackened in flame).

Glasses No. 1 and 3 are not lead glasses (no blackening).

Glasses No. 1 and 3 are probably not the same, as they have a different appearance in the flame, they cut differently and No. 3 has a brighter lustre than No. 1.

4—An expansion test was made with No. 1 against No. 3. Glass No. 1 is quite a little higher in expansion leading to the thought that No. 1 may be a soda lime glass and No. 3 a borosilicate.

5—Samples of all three glasses were tested for specific gravity by the flotation method. No. 1 is much lighter than either No. 2 or 3. No. 3 is a little lighter than No. 2. Evidently No. 3 must be a barium glass rather than a borosilicate glass or else No. 1 is a borosilicate and No. 3 is a soda-lime.

Samples of 5 standards were introduced into the tube with the three test pieces. The standards were:

A—Borosilicate glass as (No. 159 standard).

B—Soda-lime glass (tank standard).

C—Common lead glass (punch and stem standard).

D—Best-metal lead glass (Standard B-M).

E—Barium glass (No. 108 standard).

Sample No. 1 and standard B appeared to be about the same Sp. G.

Sample No. 2 and standard C appeared to be about the same Sp. G.

Sample No. 3 and standard E appeared to be about the same Sp. G.

Sample A floated definitely when No. 1 and B were at the bottom of the tube with all the other samples.

Expansion tests with each of these glasses against the standards showed:

Standard A lower in expansion than No. 1, 2 and 3.

Standard B about the same in expansion as 1, higher than 2 and 3.

Standard C about the same in expansion as 2 and 3.

Standard D lower in expansion than 1, 2 and 3.

Standard E about same in expansion as 2 and 3.

CONCLUSIONS

No. 1 and B are the same—plate 1 is soda-lime glass.

No. 2 and C are the same—plate 2 is semi-lead glass.

No. 3 and E are the same—plate 3 is barium glass.

Further tests of refractive index and workability would undoubtedly merely serve to confirm the above. If, however, the factory should be making two different soda-lime glasses, the confirmation of the tests by accurate measurements of either specific gravity, refractive index, and softening point or by all three become more important or necessary.

Simple as these tests may be, they become powerful tools in skilled hands. There are many uses to which they may be put, from identification of cullet to control of manufacturing processes. Naturally there are many more tests of physical properties that may be made. As an example, "Vita" glass may readily be distinguished from ordinary window glass because of the high ultra violet transmission of the "Vita" and the virtually complete absorption by the window glass. Such a test requires a source of ultra-violet and fluoroscope or U. V. spectrometer. Again, one colored glass may be differentiated from another by measurements of spectral transmission with a spectro-photometer. Such apparatus is not generally available, and if it were the tests are not quickly made nor of wide enough utility. The tests we have described are of broad utility as evidenced by several years of satisfactory usage.

Review: Variations Caused in Heating Curves of Glass by Heat Treatment

By A. Q. TOOL and C. G. EICHLIN

(Bureau of Standards Research Paper 292, April, 1931)

HISTORICALLY the purpose of annealing glass was to get it soft, the same idea as is present in the annealing of steels. Unannealed glass is said by the workmen to be "hard"; it does not cut well under the diamond or wheel, but "flies" and splinters.

The hardness, as measured on Moh's scale is in fact but little changed, and the glass is better described as "difficult" than "hard." The main thing that is wrong with it is the presence of severe stresses caused by the thermal gradients present during cooling. If the cooling is slow, the stresses are light, and sheet glass cuts smoothly and bottles do not break when a chip is dropped inside them.

Annealing of glass thus came to be defined as the removal of strains that were naturally produced by too rapid cooling.

It has been known for a generation or more now that annealing does other things; it increases the density and refractive index as a rule, greatly reduces the electrical conductivity, and presumably causes internal rearrangements of the molecules.

For bottles and sheet glass we are rarely interested in such matters, but for the highest qualities of optical glass they may be matters of great importance. The nature of the changes, that is the molecular changes, is as yet unknown, but there has been much activity of late in investigating them.

At present there does not seem to have been any very complete correlation established between the polariscopic strains and the other phenomena. Dr. Berger, for instance, has recently produced a paper in which he argues that the strains are purely subsidiary to the changes of state of aggregation. His evidence is not very convincing, seeing that the observed phenomena in the polariscope can very largely, and perhaps entirely, be accounted for without any reference to states of aggregation, except such states as must necessarily follow from the strains themselves.

In the present paper Drs. Tool and Eichlin investigate in a painstaking way what happens when a very carefully annealed glass is reheated; they find that at a temperature in the annealing range the glass suddenly demands an excess of heat; that is, it needs heat to change its internal state, as well as to get hotter. This demand for additional heat is known as an endothermic reaction, and is of the same character, perhaps, as the latent heat demanded of ice before it will melt and increase its temperature. The ice can be heated from Arctic temperatures to 32 F., but before it can be made any hotter it must absorb heat to change its internal state, which makes it water.

A piece of badly chilled glass, on the other hand, when reheated, *gives out* heat at about the same temperature, or a slightly lower one. This is an "exothermic" reaction, and likewise implies some internal rearrangement. Having done this, it may then show some sign of going through an endothermic reaction.

Drs. Tool and Eichlin are pioneering in a difficult land; their report is not easy reading, but we shall look forward to interpretations later.—*F. W. P.*

The Manufacture of Rolled Plate

By ERNST LUTZ *

(*Continued from the August, 1931, issue*)

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them.

"THE continuous principle was adapted to the grinding and polishing process as follows: Instead of bringing single circular tables covered with glass under the grinding and polishing apparatus, one by one, rectangular tables were joined at their short sides to one endless string, thus forming the grinding and polishing line. The tables slide on rails and wheels, or better, on accurate guides much the same as are used for the precise guides of machine-tools such as planing machines. Above the line of tables the grinding and polishing heads are mounted successively. While on the round tables the same tool has to grind in succession first coarse and then fine, on the continuous line at least one tool is assigned for each grade of sand, or, in other words, the same tool works always the same grade of sand or rouge respectively, consequently always doing the same sort of work.

"The tables joined to the endless line and covered with glass travel under the grinding and polishing apparatus to the finishing end of the line. There the glass is taken off and the empty table detached from the series and returned underground or sidewise to the same line, (Figs. 135 A, 135 B, 135 C and 135 D), or the table joins a line which runs parallel to the first line in the opposite direction. (Figs. 135 E, 135 F, 244 and 245).

"Grinding and polishing lines are constructed in widths up to 15 ft. and lengths up to 1000 ft. or more. As the tables are joined accurately in one line the glasses may be laid over the joints thus permitting greater liberty in the choice of sizes of the rough glass and resulting in a minimum of waste.

"The scheme of the rolled plate glass plant of the Ford Motor Company is shown by Fig. 244. From this figure may also be seen how extremely clever and space-saving is the way by which tank furnace, annealing oven and grinding and polishing line are built together. How far this concentration goes may be seen from Fig. 135 G, showing the annealing oven and sand grading arranged directly sideways above the grinding and polishing line. Ford produces but small continuous sheets of about 42 in. width. Consequently, the grinding and polishing line is about 42 in. wide, too. The single tables run on rolls. It is very difficult to construct rolls and rails as accurately as the continuous process requires for complete success. Slight movements of the tables easily cause poor results in the fine grinding at the joints. Fig. 135 H shows a polishing tool of the Ford Motor Company. The polishing blocks as such are

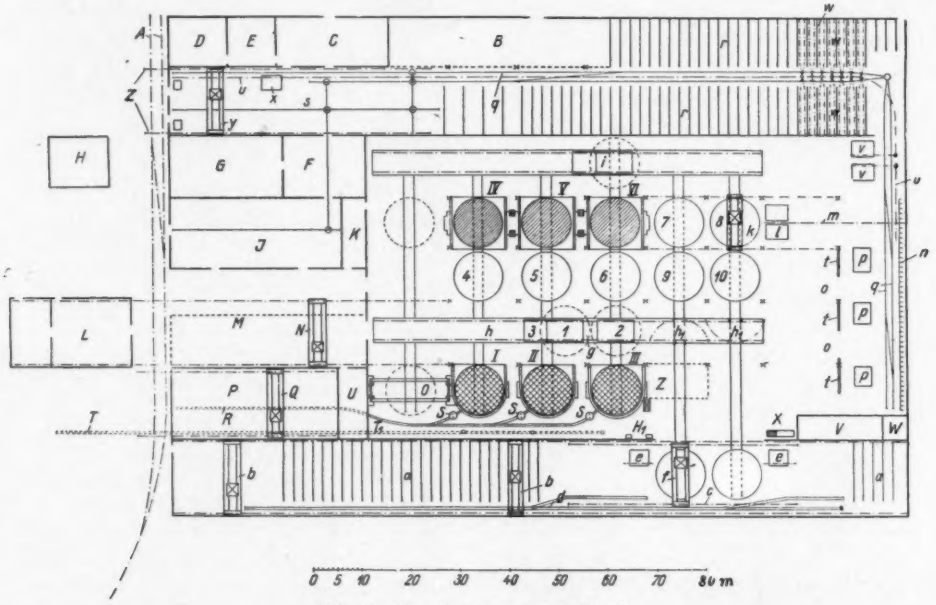

FIG. 125 (*Repeated from August Issue*)

* Of Desseau, Germany. This work is appearing in German in the new edition of *Dralle-Keppeler*, "Die Glasfabrikation."

FOOTNOTE: In the Figures, originally prepared for use eventually in the new edition in the German language of *Dralle-Keppeler*, "Die Glasfabrikation" in 1931, dimensions are given in metres (*m*) and millimetres (*mm*). We would like to have given these in feet and inches but the translation and the making of nearly two hundred and fifty new illustrations would have involved a prohibitive loss of time and expense. To some of our readers the metric system is as familiar as the English units; for the others we may say that a metre is approximately 40 inches, and a millimetre is approximately 1/25 of an inch. A thousand millimetres, of course, go to a metre.—*F. W. P.*

similar to the polishing apparatus with round tables. They consist of iron discs to which the felt is fastened by an iron ring. The feeding with rouge is done automatically and controlled by electrically controlled valves.

"The system of grinding and polishing in use by the Ford Motor Company was designed particularly for tables of small widths and exclusively constructed for the manufacture of automobile glasses, particularly windshields. The Pittsburgh Plate Glass Company, however, as a manufacturer of large show window glasses, developed the system for the manufacture of large sheets. Accordingly, the apparatus had to be at least 10 ft. wide. No difficulties arose from this extension as far as the grinding was concerned, but the polishing caused difficulties. The grinding could easily be arranged in the continuous process; the successive working of the surface of the glass with different grades of sand can be executed even better continuously than non-continuously. When using grinding machines with circular tables and the same heads for all grades of sand, there is always the risk that residues of the coarse sand may stick to the runners in spite of thorough washing and later on may get loose during the process of smoothing, thus spoiling it. This would not happen with the continuous grinding line as each tool works with the same grade of sand all the time. One just has to adjust scrapers to avoid the misplacing of the different grades of sand.

"It was not so easy to make the polishing process a continuous one, either. The polishing is done by the circular apparatus as follows: Before the operations begins, the felts are washed thoroughly before they are gradually supplied with rouge thus exerting on the surface of the glass in the beginnning a scraping and later on a rubbing effect. The last polish is conferred on the surface as the rouge is drying more and more, at last working with but a thin layer. This is limited by the point where the rouge becomes caked. These cakes may get loose, come under the felts, and spoil the polish with so-called polishing sleeks. The washing at the beginning of each polishing process is to remove the caked rouge from the felts. The continuous polishing line does not permit off-hand for the alternating working and washing of the felt. Therefore, the danger of incrustation of the felts and polishing sleeks constituted the most important problem in making the polishing process a continuous one. The difficulties were overcome in different ways. For the narrow tables of the Ford Motor Company it was an easy matter because all of the felts frequently come over the edges of the narrow tables and are so cleaned by scraping. Further, automobile glasses do not need so fine a polish as store front windows and sheets to be silvered. Therefore, the problem is of much greater importance to a polished plate glass manufacturer than it is to an automobile builder like the Ford Motor Company.

"The Pittsburgh Plate Glass Company solved the problem by installing the runner frames of their polishing apparatus so that they can be exchanged or tilted easily as described in the U. S. patents 1,501,327 of John H. Fox and 1,548,105 of Jacob Soderberg. After a certain period of time has elapsed, each of the runners is either tilted and the

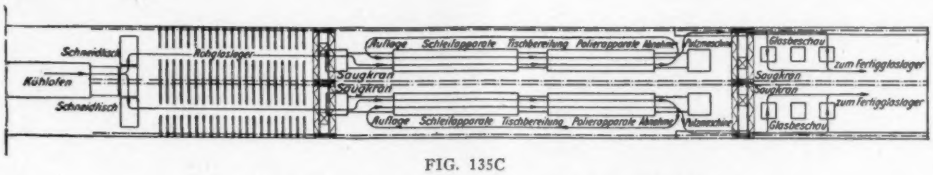

FIG. 135C

TRANSLATION OF DESCRIPTIVE TERMS ON DRAWINGS

Schleifapparate—Grinding Machines.
Polierapparate—Polishing Machine.
Tischbereifung—Jointing.
Abnahme—Stripping.
Putzmaschine—Cleaning Machine.
Kühlofen—Lehr.
Schneidtisch—Cutting Table.
Rohglaslager—Rough Glass Racks.
Fertigslaslager—Finished Glass Racks.
Saugkran—Vacuum Crane.
Auflage—Laying Yard.
Glasbeschau—Inspection.

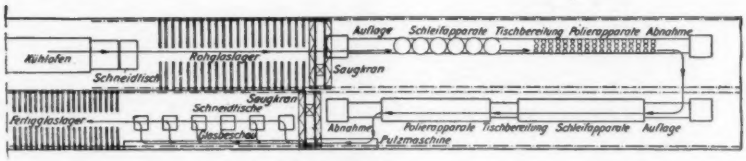

FIG. 135E

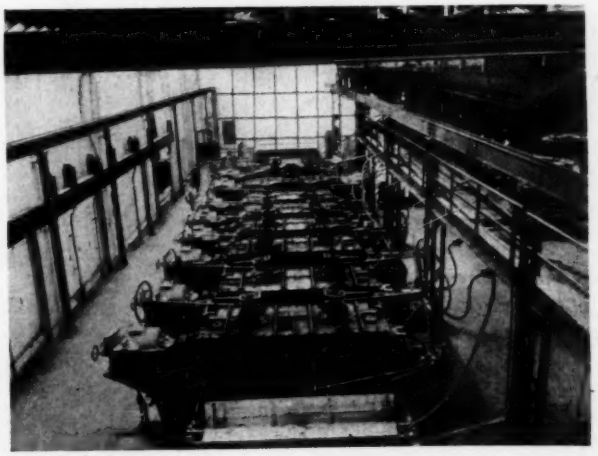

FIG. 135D

individual felts are cleaned by scraping or the whole runner frame is removed by a crane and exchanged for a freshly cleaned one.

"A different system was developed by the firm of Pilkington Brothers, Limited, the European pioneers of the continuous grinding and polishing line. According to U. S. patent 1,781,226 a truck carrying a pan made of tin is installed aside the line of tables. The polishing blocks are raised and the washing pan is pushed between the felts and the tables; then the runner frame is lowered and the felts washed by rotating on the tinplate and being watered at the same time.

"Another solution of the problem is found in the U. S. patent 1,582,808 of L. von Reis. The polishing machines

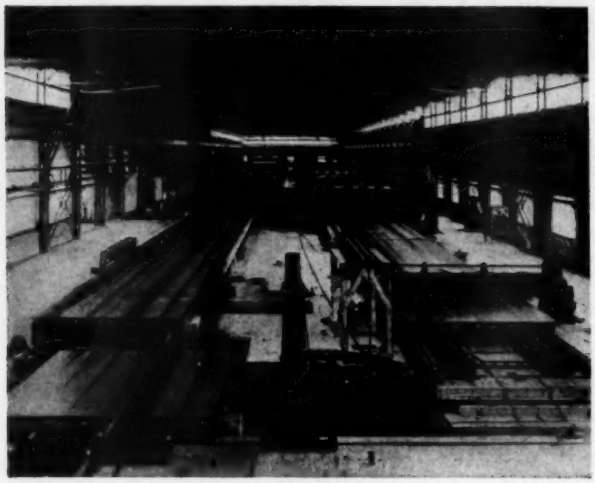

FIG. 135F

travel in the same direction as the glass tables, but with a slower motion. When they have arrived at the finishing end of the line of tables, they are taken off and automatically cleaned, whereupon they are returned and started anew at the starting end of the polishing process. The scheme of this is shown in Fig. 135 J.

"Fig. 135 F shows the continuous grinding line used by the General Motors Company where the felts are cleaned according to the L v. Reis patent. This equipment consists of 2 parallel lines of tables about 750 ft. long and running in opposite directions The tables are about 15 ft. wide and 13 ft. long, and travel forward on the first line and, at the finishing end, the glass which is ground and polished on one side is taken off. Then the tables are pushed over a sliding platform (seen in the foreground of the figure) to the second line of tables which travels backward, and the glasses are reset with the polished sides down. In the figure the guideways of the tables and, at the right, the automatic washing device for the polishing felts can be recognized.

"While the constructions of the Ford Motor Company and of the Pittsburgh Plate Glass Company employ but one single grinding and polishing tool for the entire width of the glass to be treated, the constructions built according to the Pilkington and Heuze patents use several tools coordinated side by side. This arises from the great width of the tables. The working of so large a glass with one single tool would require a too big and too heavy tool. Therefore, several working tools are installed side by side in some such way as described in the German patent specification 375,925 (Figs. 134 and 135). In order to make the distribution of the working of the glass surface more uniformly spread over the entire width of the table, the holder of the tools gets a simultaneous oscillating motion. The uniformity can also be improved by the construction of oval tools (Fig. 135 K, grinding tool of the continuous grinding line of the Herzogenrather Glasswerke) or by displacing the shafts of the tools with respect to each other. (Figs. 135 L and 135 M.) The latter figure shows the working curve of two polishing blocks. From this curve, the effect of the displaced shafts can be seen.

"Although the development of the continuous grinding and polishing line is not yet quite 10 years old, these machines have been introduced very quickly into the polished plate industry and taken the place of the old rotating polishing apparatus. The apparatus, with tables of up to 15 ft. widths and lines of more than 1,000 ft. lengths, the weights of some of these machines exceeding 3,000 tons, represent giant plants the dimensions of which come near to those of large modern steel work and rolling mills.

"The grinding and polishing processes have been improved until an excellent quality of finish has been achieved and this with a much greater constancy than was secured previously by the old rotating apparatus. The traveling speed of the tables and the output of the grinding and polishing constructions depends, of course, on their lengths. An extensive line of tables with many grinding and polish-

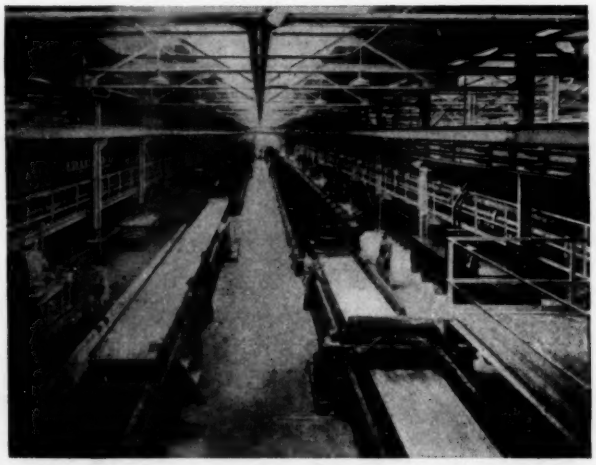

FIG. 135G

ing tools can work considerably faster than a short line. The customary speed lies between 100 ft. to 300 ft. per hour, i.e., the output that can be obtained is from 2 million to 20 million square feet per year, depending on the width. The continuous grinding and polishing apparatus being a means of mass production shows considerably better results in large units than in small.

"Details of the theoretical working conditions and polishing may be obtained from the report, 'Arbeitskurven der

Werkzeuge bei Spiegelglas - Schleif - under Polierbahnen' ('Working curves of the tools in rolled plate glass grinding and polishing lines') which was given by Dr. Ing Thomé, Aachen, at the 14th glass technical meeting of the Deutsche Glastechnische Gesellschaft from November 13 to November 15, 1930, in Berlin. This report will be published before long in the *Glastechnische Berichte* der Deutschen Glastechnischen Gesellschaft in Frankfurt/Main."

As regards the above-mentioned U. S. patents 1,501,327 and 1,548,105 of the Pittsburgh Plate Glass Company and 1,582,808 of L. von Reis the following may be added: In the introduction to the chapter, "The grinding and polishing of the rough glass," and later, on different occasions, it had been pointed out that the polishing felts become greasy while they are used and encrusted from rouge and sometimes are filled with glass splinters; and that therefore frequent washing and cleansing of the felts is indispensable if a good and unimpaired polish is to be secured. As stated in the above report, this necessity of washing and cleansing the felts at first constituted a great obstacle to the carrying through of the continuous polishing process; it must be added that the felts wear out in a relatively short time and, therefore, must be renewed frequently. Thus it was of greatest importance upon the introduction of the continuous grinding and polishing lines to find ways of inspecting, cleansing and exchanging the felts without disturbing the continuity of the work.

According to U. S. patent 1,501,327 (Figs. 135 N and 135 O) the requirements are met through the suspension of the entire runner frame 13 in such a way that it can be tilted easily into an inclined position as indicated by the dotted lines in the figure. In this position, the lower surfaces of the runner blocks can be examined easily, scraped, and cleaned, and every single block 14 can quickly be supplied with new felts, if necessary. Paralleling the line of tables, a truck is located on a runway carrying a wash-

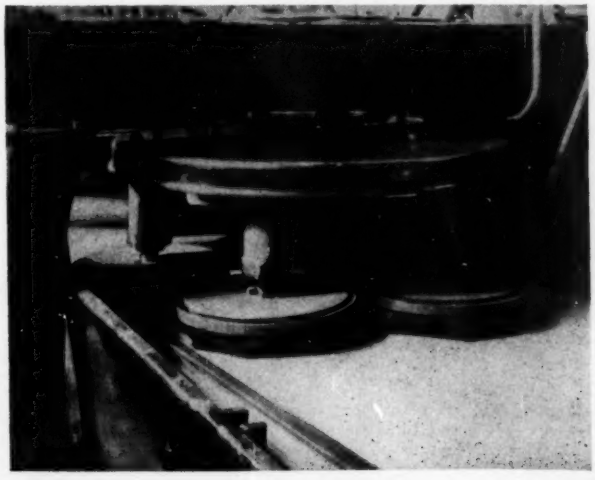

FIG. 135H

ing table 30 the plate of which is formed similar to a pan and can be slid under the tilted felts in order to protect the glass and the neighboring parts of the apparatus from dirty

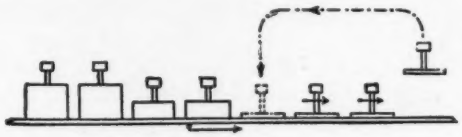

FIG. 135J

water, from hard crusts, glass splinters, etc., that must be removed. The truck carrying the washing table carries not only the water used for the washing, cleansing tools such as

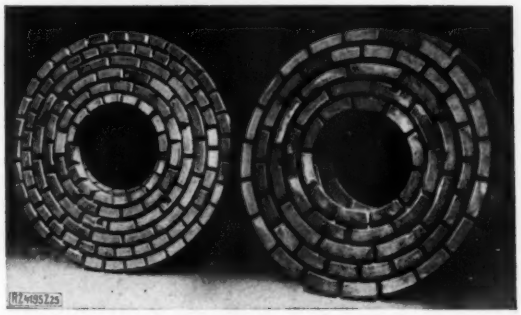

FIG. 135K

brushes, scrapers, etc., but fresh polishing blocks and various tools needed for exchanging them.

The rotating and suspending shaft 10 of the runner frame

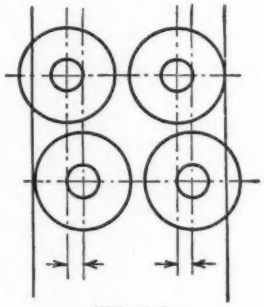

FIG. 135L

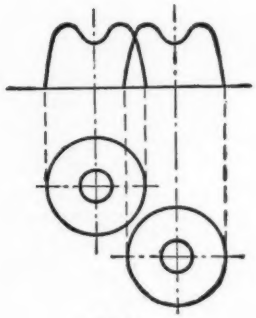

FIG. 135M

13 is journalled with its upper and lower ends in the tubular support 9 which is suspended above with the trunnions 17 in the forked lever 15. The forked link 23 is pro-

vided with grooves 26 acting as guides for the trunnions 25 at the lower end of the support 9. Lever 15 and link 23 rest at 18 and 24 respectively in the bracket 2 which is adjusted to the main framework. In order to keep the runner frame 13 in a secure working position, i.e., to keep the shaft 10 and the tubular support 9 in their vertical positions, the trunnions 25 are held against outward movement in the grooves 26 by means of the two cap members 33 fixed to link 23. Before the runner frame is swung around the trunnions 17, it must be lifted by means of the hand wheel 22, the threaded spindle 20, and the lever 15. After the two cap members 33 have been released, the runner can be swung to the right into the position as indicated by the dotted lines. It is held in this position by means of the trunnions 25 which are hooked by the two latches 36 adjusted to the end of the link 23. In the two figures, the numeral 3 indicates the table carrying the glass to be polished, 11 the electric motors driving shafts 10 through the intermediary of reduction gearing located in the casing 12.

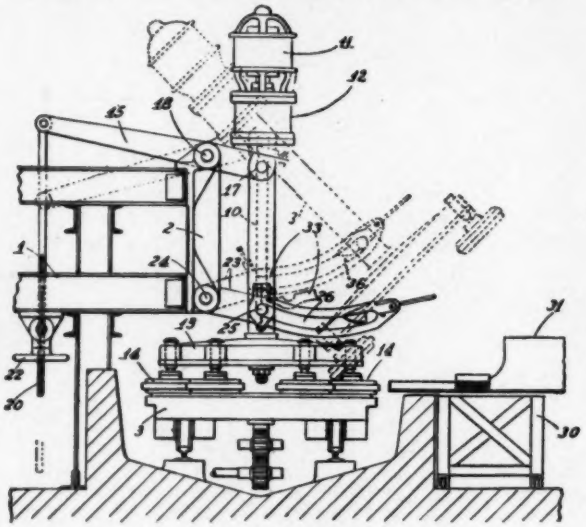

FIG. 135 N

The U. S. patent 1,548,105 (Figs. 135 P, 135 Q, 135 R) attains the desired effect by adjusting every single block 47 to the runner frame 33 in such a way that it easily can be swung alone into the inclined position. The spindle 48 of the block 47 rotates in a pair of bearings 50 and 51 to which the links 53 and 54 forked at their ends are pivoted. The links 53 and 54 are also pivoted to the runner frame 33. If the block is to be swung outwardly, the bolt 57 is pulled out and the loosened end of the lower link is fastened with the bolt to the hole 58 of the runner frame. Thus, the inclined runner holds itself in a certain position. If another position is desired a piece of wood 59 may be put between.

This method of construction has, at the same time, the advantage that the felts, in spite of possible tiltings of the runner frame, are permitted to keep constantly in parallel relation with the glass surface, for the runners 47 are attached to the runner frame in such a way that they can freely move up and down in vertical direction. In order to make the movability of the runners a perfect one, they are connected to the spindles 48 by the ball joints 49. Moreover, the fact that the runners are mounted in the runner frame by means of pairs of links, permits for a convenient regulation of the pressure the felts apply to the glass. By reason of the centrifugal force the links tend to keep in

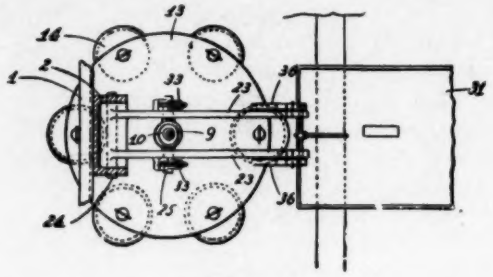

FIG. 135 O

horizontal position. When the runner frame is lowered (Fig. 135 S), this is followed by an increase of the pressure which was previously caused by the weight of the block with its spindle and all its other parts. When, on the other hand, the runner frame is raised from normal position, the pressure is decreased (Fig. 135 J).

As can be seen from the pictures, the tilting devices of the patents described above can be installed advantageously only if the main frameworks which hold the runner frames are one-sided thus permitting access without hindrance from the other side. If the frameworks are double-sided as, for instance, in Fig. 129, the tilting devices cannot well be used, nor are they convenient with very wide tables as may be seen in Fig. 135 B. For continuous polishing lines of this type the problem was solved in a successful way by U. S. patent 1,582,808. The solution found by this patent can be easily understood from Fig. 135 J and the explanations given

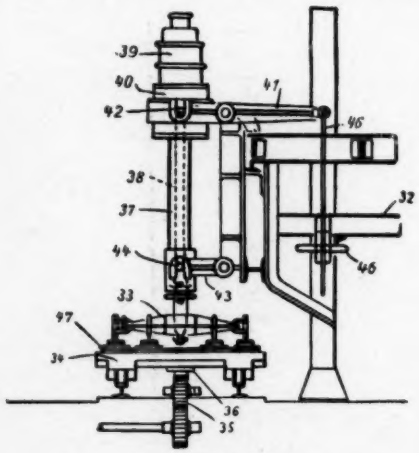

FIG. 135 P

there. One advantage of this solution is also that one may take one's time for the cleansing and exchanging of the felts without being obliged to defer noticeably the work on some point of the polishing line.

"The continuous principle was adapted to the grinding and polishing process as follows: Instead of bringing single circular tables covered with glass under the grinding

and polishing apparatus, one by one, rectangular tables were joined at their short sides to one endless string, thus forming the grinding and polishing line. The tables slide on rails and wheels, or better, on accurate guides much the same as are used for the precise guides of machine-tools such as planing machines. Above the line of tables the grinding and polishing heads are mounted successively. While on the round tables the same tool has to grind in succession first coarse and then fine, on the continuous line at least one tool is assigned for each grade of sand, or, in other words, the same tool works always the same grade of sand or rouge respectively, consequently always doing the same sort of work.

"The tables joined to the endless line and covered with glass travel under the grinding and polishing apparatus to the finishing end of the line. There the glass is taken off and the empty table detached from the series and returned underground or sidewise to the same line (Figs. 135 A, 135 B, 135 C and 135 D), or the table joins a line which runs parallel to the first line in the opposite direction. (Figs. 135 E, 135 F, also 244 and 245, to appear later).

"Grinding and polishing lines are constructed in widths up to 15 ft. and lengths up to 1,000 ft. or more. As the tables are joined accurately in one line, the glasses may be laid over the joints, thus permitting greater liberty in the choice of sizes of the rough glass and resulting in a minimum of waste.

"The scheme of the rolled plate glass plant of the Ford Motor Company is shown by Fig. 244. From this figure may also be seen how extremely clever and space saving is the way by which tank furnace, annealing oven and grinding and polishing line are built together. How far this concentration goes may be seen from Fig. 135 G, showing the annealing oven and sand grading arranged directly

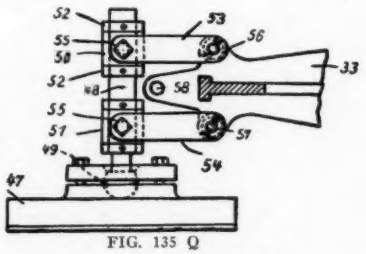

FIG. 135 Q

sideways above the grinding and polishing line. Ford produces but small continuous sheets of about 42 in. width. Consequently, the grinding and polishing line is about 42 in. wide, too. The single tables run on rolls. It is very difficult to construct rolls and rails as accurately as the continuous process requires for complete success. Slight movements of the tables easily cause poor results in the fine grinding at the joints. Fig. 135 H shows a polishing tool of the Ford Motor Company. The polishing blocks as such are similar to the polishing apparatus with round tables. They consist of iron discs to which the felt is fastened by an iron ring. The feeding with rouge is done automatically and controlled by electrically controlled valves.

"The system of grinding and polishing in use by the Ford Motor Company was designed particularly for tables of small widths and exclusively constructed for the manufacture of automobile glasses, particularly windshields. The Pittsburgh Plate Glass Company, however, as a manufacturer of large show window glasses, developed the system

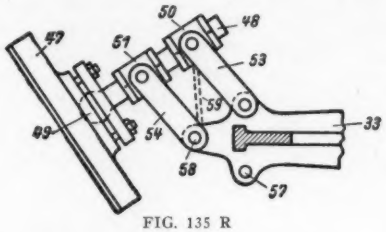

FIG. 135 R

for the manufacture of large sheets. Accordingly, the apparatus had to be at least 10 ft. wide. No difficulties arose from this extension as far as the grinding was concerned, but the polishing caused difficulties. The grinding could easily be arranged in the continuous process; the successive working of the surface of the glass with different grades of sand can be executed even better continuously than non-

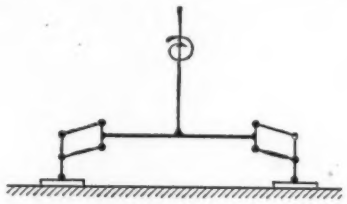

FIG. 135 S

continuously. When using grinding machines with circular tables and the same heads for all grades of sand, there is always the risk that residues of the coarse sand may stick to the runners in spite of thorough washing, and later on may get loose during the process of smoothing, thus spoiling it. This would not happen with the continuous grinding line as each tool works with the same grade of sand all the time. One just has to adjust scrapers to avoid the misplacing of the different grades of sand."

(To be continued)

Adressbuch der Glasindustrie, 1931

This book, published in the German language by Verlag des Sprechsaal, Muller & Schmidt, Coburg, Germany, is a voluminous directory of 960 pages not including the advertising, covering the glass manufacturing industry of Europe by countries. It is separated into sections as follows: One, glass works; two, smelting works for soluble glass; three, quartz glass industry; four, work shops for glass blowing; five, work shops for grinding, engraving, refining, painting, etching of glass, silvering of mirrors, sand blasting, mosaic work; six, listing of representatives of the glass industry as resulting from the data given in the first five parts; seven, glass industry employers protective associations, professional training schools, state technochemical laboratories, offices for the study of heat economy, associations, societies and trading companies; eight, alphabetical summary of registered trade marks, etc., list of manufactures, names of firms listed in the first five sections arranged according to localities, classifications of the glass industry arranged according to countries and provinces, alphabetical list of advertisers.

The Adressbuch des Glasindustrie, 1931, is an unusually comprehensive and reliable directory and it should prove invaluable to any firms desiring to reach the glass industries of Europe and the Mediterranean countries.

Glass Industry

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Vol. 12 — SEPTEMBER, 1931 — No. 9

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Wages

EVER since the collapse of the 1929 boom, efforts have been made to forestall any talk of the reduction of wages. Occasionally, however, some voice is heard in the wilderness, timidly suggesting that since prices have gone down, a proportionate reduction of wages would not hurt, and might help, inasmuch as men at work at reduced wages earn more than those who are laid off jobs at high wages, Henry Ford is very emphatic in his insistence on high wages, but it does not necessarily follow that Henry Ford is right.

The situation at the moment is this: the farmer is getting, say fifty cents on the dollar for his wages. In so far as he is a capitalist, having money invested in his farm, his capital is worth fifty cents on the dollar also.

The farming community is nearly half the United States and therefore half the United States has lost half its income and in effect half its capital. The manufacturing capitalist and the industrial laborer comprise most of the other half. The ambition of these is to avoid reducing return on manufacturing capital or reduction of wages.

But automobiles and triplex windshields cannot be sold to the farming half of the community unless the cost thereof can be reduced by half. The only quick way to reduce costs by half is to write the capitalization down by half and cut wages in two.

Now Henry Ford does not want to lose half his capital, and his workmen do not want to lose half their wages. And even if they did not object, other capitalists and workers would. And owners of Government bonds would be horrified if Andrew Mellon announced that all $1,000 bonds would become $500 from that day forth.

Yet it is precisely such an adjustment that seems needed to restore the farmers and producers of raw materials to the purchasing community and to permit us to start up industry once more.

Theoretically it is the right thing. If rents, clothes, food, automobiles and movie shows cost only half as much as in 1929, we ought to be content with wages at half 1929 figures and bonds and stocks at half price.

This would be a great help in another way. We could lower our tariff walls and still the European nations could not dump goods here, because our domestic costs would have been cut in half. They would have to outdistance us in more subtle matters than cheapness of labor to compete with us; and further, we could compete with them on more equal terms in South America and the Orient.

From a practical point of view, however, the difficulties are very great. Everyone will object to his own savings being written down to fifty cents on the dollar, to his home being reduced in value to half of what he paid for it a few years ago, or to his wages being cut in two. Since the change cannot be made, in our disorganized country, simultaneously everywhere, it can only be made by a slow and painful process. Since bondholders will not take fifty cents for their dollar, common stocks must decline by more than fifty per cent, and many companies must go broke. Since the laborer will not work for half price, he must be out of work half

the time. Since capital must retain its ancient nominal value, the interest rates must be halved and dividends passed. It is a difficult situation, and is due in a great measure to the belief, carefully fostered during the last ten years, that American prosperity could be best achieved by keeping the rest of the world as poor as possible.

We now find that our export trade is important; that our cotton and copper and corn and cow-meat must to some extent be sold abroad, and that our farmers and raw materials producers must compete in world markets. Our only hope is to help by every means in our power to raise wages abroad unless we want to reduce them here.—*F. W. P.*

The New Journal "Physics"

IN July the American Physical Society issued the first number of a new journal bearing the name PHYSICS. The necessity for the establishment of a new journal is explained as being due primarily to the fact that THE PHYSICAL REVIEW, hitherto the only outlet provided by the Physical Society for the publication of original research, has become overcrowded, and gradually has become more and more the exponent of the purely introspective side of physics.

During the last six years THE PHYSICAL REVIEW has more than doubled in size and has become specialized in character because of the congestion. The result has been that this journal has published principally the work of what might be called the academic groups of physicists, while the professional or industrial physicist has had to publish his writings in a wide variety of engineering, chemical and other types of journal. PHYSICS is being put forth in the expectation that it will better serve this latter group of physicists as a medium for exchange of methods and ideas.

The first number reminds one of THE PHYSICAL REVIEW dressed in a new red cover, but a glance into its interior shows promise that here may be articles intelligible even to those of us who have had to neglect higher mathematics a bit, for the more mundane pursuit of the sources of trouble in glass tanks.

The new journal has a section, the Editor's Column, wherein is given a brief review of current work, so that, for example, the reader may keep in partial touch with what the quantum mechanists are attempting to do. The current summaries are from the pen of Professor J. H. Van Vleck, of the University of Wisconsin.

Beginning with the second issue is promised a section devoted to Engineering News and Notes. The editors promise other features of a similar character.

There has been and is real need for this new journal, and THE GLASS INDUSTRY wishes it the complete success to which it is justly entitled.—D. E. S.

How Many Times Is Your Glass Melted?

By JAMES BAILEY [1]

EACH time that glass is melted certain changes take place during the process. Some of the alkali is vaporized, clay and other foreign matter is absorbed by the glass, color may burn out, certain of the ingredients may be oxidized or reduced resulting in changes of hue or deepening of color, and certain other physical changes take place. It is therefore of interest to know the average number of times that the glass has been melted after a certain number of fills have been made. This average depends upon the ratio of batch to cullet from which the fill is made.

The problem works out into what is known in mathematics as an "infinite series," but for any reasonable percentage of batch a nearly constant value is soon established.

As an example, suppose that we are melting glass in pots. We shall assume that all the glass is worked out of the pot each melt, and that it is necessary to make the first melt entirely from batch. It is obvious that all the glass gathered from the first melt will have been melted but once.

Now suppose all succeeding fills are made with sufficient batch to make half of the glass, and the other half is cullet. The glass gathered the second time will consists of one half batch which has been melted but once, and one half batch which has been melted twice. The average will have been melted $(\frac{1}{2} \times 1) + (\frac{1}{2} \times 2) = 1\frac{1}{2}$ times. Similarly, the gathers after the third melt will be one half melted once, plus one quarter melted twice, plus one quarter melted three times or $(\frac{1}{2} \times 1) + (\frac{1}{4} \times 2) + (\frac{1}{4} \times 3) = 1\frac{3}{4}$ times. In like manner the series may be extended to cover any number of melts and any batch cullet combination.

The series becomes:

$$A = Xm_1 + XYm_2 + XY^2 m_3 + XY^3m_4 + XY^4m_5 + XY^5m_6 \ldots\ldots + XY^{(n-2)}m_{(n-1)} + Y^{(n-1)}m_n$$

and the series approaches $\frac{1}{X}$ as a limit for an infinite number of melts.

In this series:

$$X = \frac{\text{BATCH GLASS EQUIVALENT}}{\text{GLASS EQUIVALENT OF FILL}}$$

$$Y = \frac{\text{CULLET}}{\text{GLASS EQUIVALENT OF FILL}}$$

A = Average times melted after n fills.

m_1 = melted once.
m_2 = melted twice.
m_3 = melted three times, etc.

To save the tedious computations which such a series involves, the results have been reduced to the graph which appears in connection with this article. The graph may be put to practical use as follows:

Suppose the fill consists of 750 pounds of batch and 1400 pounds of cullet. The batch weight should be reduced to

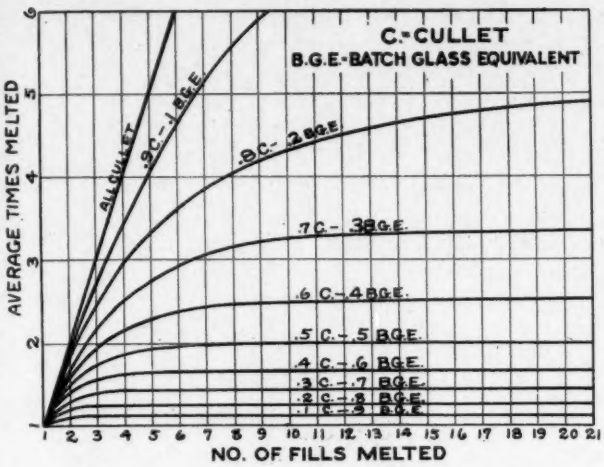
[1] Of Bailey & Sharp Co., Inc., Consulting Chemists, Hamburg, N. Y.

equivalent glass pounds. If one pound of batch makes 0.8 pounds of melted glass then the fill consists of 600 glass-equivalent pounds, and 1400 pounds of cullet, or 0.3 batch and 0.7 cullet.

Suppose that this is a new type of glass and that the cullet has been taken each time from the previous melt. Then using the curve of 0.3 batch-equivalent and 0.7 cullet, the average number of times the glass has been melted may be directly read at the left for any number of fills.

Practical results will vary somewhat from the value shown because of the fact that the amount of cullet used generally increases or decreases according to production and the ratio of batch to cullet is not kept constant. Nevertheless, the curves show that when the batch is half or more of the total fill a reasonably constant condition is reached after a very few melts, but that changes are still going on after a large number of melts when the fill consists of large quantities of cullet.

These curves may help to explain why high cullet ratios are not suitable to certain kinds of glass, and why some manufacturers have found it advisable to establish a maximum ratio of cullet per fill, even though excess cullet is produced.



Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

SHEET GLASS DRAWING APPARATUS. U. S. 1,818,205. August 11, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 6/21/28.

PROCESS FOR THE PRODUCTION OF PLATE GLASS BLANKS. U. S. 1,818,206. August 11, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 7/20/28.

PROCESS OF AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,818,207. August 11, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 7/26/28.

APPARATUS FOR FORMING AND ANNEALING SHEET GLASS. U. S. 1,818,208. August 11, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 8/2/28.

PROCESS AND APPARATUS FOR PRODUCING SHEET GLASS. U. S. 1,818,209. August 11, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 5/13/29.

METHOD AND APPARATUS FOR PRODUCING MOLTEN GLASS. U. S. 1,818,203. Aug. 11, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 7/27/27.

PROCESS AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,818,204. August 11, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 1/20/28.

PROCESS AND APPARATUS FOR FORMING SHEET OR PLATE GLASS U. S. 1,814,905. July 14, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 4/5/26.

GLASS-WORKING MACHINERY. U. S. 1,789,011. Jan. 13, 1931. Roy D. Mailey, East Orange, and Wilford J. Winninghoff, South Orange, N. J., assignors to General Electric Vapor Lamp Company, Hoboken, N. J. Filed 1/25/27. In a machine for joining hollow glass, means for holding two pieces of hollow glass in alignment, means for relatively moving pieces held by said holding means relatively toward and from each other, means for moving pieces in said holding means relatively transversely of each other comprising a support member for one of said glass holding means and a ball and socket joint in said support member, means for heating glassware held in said holding means, and means for applying and for varying air pressure in said glass pieces.

GLASS. U. S. 1,814,507. Charles Edwin Gould, Wilfred Marsh Hampton, and Harold Sharpe Martin, West Smethwick, England, assignors to Chance Brothers and Co., Limited, West Smethwick, England. Filed 3/14/29 and in Great Britain 3/19/28. A batch for making glass especially transparent to ultra-violet radiation of wave lengths below 3,200 Angstrom units consisting of silica 560 parts, borax 527 parts and powdered metallic zinc 8 parts.

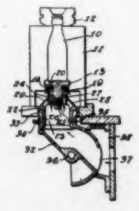
LAMINATED GLASS AND PROCESS OF PRODUCING THE SAME. U. S. 1,818,458. August 11, 1931. Wilbur F. Brown, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 12/9/27. The process of producing laminated glass consisting in humidifying a sheet of non-brittle material, then interposing the humidified sheet between two glass sheets, and uniting the same.

SHEET GLASS APPARATUS. U. S. 1,818,231. August 11, 1931. Leopold Mambourg, Lancaster, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 3/11/26.

APPARATUS FOR THE MANUFACTURE OF SHEET OR PLATE GLASS. U. S. 1,818,154. August 11, 1931. William E. Nobbe, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 5/13/29.

APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,815,288. July 21, 1931. Robert L. Clause, Sewickley, Pa., assignor to Pittsburgh Plate Glass Company. Filed 7/25/29.

MACHINE FOR FORMING HOLLOW GLASS ARTICLES. U. S. 1,789,471. Jan. 20, 1931. Byrne McGovern, Evansville, Ind., assignor to Owens-Illinois Glass Company. Filed 6/4/28. An object of the invention is to provide an improved form of mold bottom and air cooling means for effectively cooling the same, together with adjustable means for directing, regulating and controlling the circulation of the cooling air.



METHOD AND APPARATUS FOR DRAWING, CUTTING, GRIPPING AND CONVEYING, SHEET PLATE GLASS. U. S. 1,814,932. July 14, 1931. Charles J. Jordan, Woodbury, N. J., assignor of one-fourth to Rudolph D. Schaub, Woodbury, N. J. Filed 11/23/28.

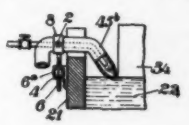
PROCESS AND APPARATUS FOR FORMING SHEET GLASS. U. S. 1,818,152, and 1,818,153. August 11, 1931. William E. Nobbe, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 1/19/28 and 1/21/28. The combination with a furnace containing a mass of molten glass and provided with an outlet through which a stream of molten glass issues, of means for directing the stream in a substantially horizontal path and reducing the same through successive stages to sheet form, including a plurality of pairs of sheet forming rolls, said rolls being constructed to reduce the thickness of the stream first at its center and to then subsequently reduce the end portions to the same thickness.

APPARATUS FOR MAKING GLASS SHEETS. U. S. 1,818,130. August 11, 1931. Howard L. Halbach, Clarksburg, W. Va., assignor to Pittsburgh Plate Glass Company, Pa. Filed 12/14/27. A fluid cooled pipe extending across the bath beneath the line of generation of the sheet, and edge holding means comprising a pair of upwardly extending members carried by the pipe and terminating at the points where the edges of the sheet are drawn from the molten body.

GLASS TANK. U. S. 1,780,164. Nov. 4, 1930. George W. Batchtell, Toledo, O. Filed 6/29/29.

GLASS BLOWING MACHINE. U. S. 1,818,725. August 11, 1931. Edward H. Lorenz, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Original application filed 8/8/21. Divided and this application filed 2/11/28.

MEANS FOR AND PROCESS OF DRAWING SHEET GLASS. U. S. 1,790,774. Feb. 3, 1931. Arthur E. Spinasse, Mount Vernon, O. Filed 8/18/19. A method of obtaining in the drawing operation alone an edge and margin of no greater thickness than the body of the sheet of glass. An anchoring device for use in drawing flat sheet glass consisting of a body decreasing in horizontal diameter transversely as respects the plane of the sheet to a diameter less than the maximum thickness of the glass being drawn at the point of generation of the edge of the sheet and means independent of the molten glass for conveying a temperature regulating medium thereto and means whereby the device is held in fixed anchoring position.



ENDLESS CONVEYOR. U. S. 1,769,818. July 1, 1930. John C. Anderson, Keyport, N. J. Filed 2/16/27. A lehr conveyor comprising a plurality of reticulated endless conveyor members superposed one upon the other and having a substantially smooth ware-supporting surface.

APPARATUS FOR MAKING GLASS TUBING. U. S. 1,770,005. July 8, 1930. Harry Y. Norwood, West Rush, N. Y., assignor to The Taylor Instrument Companies, Rochester, N. Y. Filed 1/9/28.

The Glass World and What It Is Doing

News of the Industry

Professor Turner Here for a Short Visit

Prof. W. E. S. Turner, Head of the School of Glass Technology at The University, Sheffield, England, one of the founders and Honorary Secretary of the Society of Glass Technology, Editor of the Society's Journal and contributor of scientific and other writings to that and other journals, who made a special trip from his home country to do research work at Washington, D. C, arrived in New York late in July, having crossed on the *Aquitania*.

After spending Saturday calling on friends and business acquaintances in New York and visiting with a friend, New York's latest popular attraction, Ex-Governor "Al" Smith's Empire Building Tower, "the highest building in the world," and noting the extensive employment there of glass for constructional and decorative purposes, he took a train the following day for Washington.

A number of days were occupied at the Capital City with his investigations and he then made a brief trip to the Middle West, stopping at Pittsburgh and Indianapolis.

On his arrival from England at New York it was a pleasure to observe that he was in good health, having practically recovered from his recent serious illness. To THE GLASS INDUSTRY he remarked that he very much regretted that his time during the visit would be so fully occupied with necessary professional matters that he would be unable to look up all his old friends throughout the glass manufacturing districts as engagements in England necessitated his sailing for home about the middle of August. He returned via Montreal, stopping on the way at Corning, N. Y.

Program for Glass Division Summer Meeting

The annual Summer Meeting of the American Ceramic Society in the form of an excursion on Chesapeake Bay will begin at Baltimore, Friday evening, September 11 at 6:30 P. M. the party arriving at Old Point Comfort, Va., Saturday morning. There will be informal meetings on Saturday and Sunday. The boat leaves Old Point Comfort Sunday night and arrives at Baltimore on Monday morning, September 14 at 7:30 A. M. Expenses, including transportation, meals on the boat, staterooms, and meals and room at Hotel Chamberlain will be $18.95. Ladies are invited so bring your family who will enjoy this unique meeting. Members who plan to attend should notify L. C. Roche, Maryland Glass Corporation, Baltimore, Md., as soon as possible.

Outside of a little time that will be spent on business matters the program will be entirely in the nature of discussions on various topics, and will be informal in character.

Two major topics have been selected. The first will be a discussion on standards and will be led by Dr. W. C. Taylor of the Corning Glass Works. The second will be a discussion on the use in glass of different types of lime and the advantages thereof, led by L. T. Sherwood of the Pennsylvania Wire Glass Company. Members will be privileged to bring up other matters for discussion after the two stated subjects have been exhausted.

Among the numerous diversions planned is a demonstration of strange physiological and psychological phenomena by J. W. Krisko and F. W. Preston. These will include among other things experiments on mind reading, thought transference from Mr. Krisko to Dr. Preston, from the audience to Dr. Preston and from him or Mr. Krisko to the audience.

It is believed that these phenomena can not be duplicated in the United States. The demonstration will be of such a kind as to be equally interesting to ladies and scientists.

Glass Production Increasing

During July and August a large number of glass plants, especially smaller ones, but including some important concerns, resumed manufacturing activities. A. H. Heisey Company's works at Newark, Ohio, took on, in August, it is reported, about 600 workmen.

The Louie Glass Company put 22 shops to work about the middle of the month. The Pennsylvania Wire Glass Company's plant at Dunbar, Pa., resumed operations with a force of 25 men who had been without work for several months. L. J. Houze Convex Glass Company, Point Marion, Pa., was reported to have reopened their plant. The Mt. Jewett Window Glass Company plant, recently reorganized by local interests, which was closed last February, has been reopened with new equipment.

The Mississippi Glass Company plant at Morgantown, W. Va., relit their furnace fires in July with about 150 men, and local

papers reported that H. L. Carspecken, the company manager, expressed his opinion that within a few months between 225 and 250 men would be at work. Notice was given in July that the Rodefer Glass Works at Bellaire, Ohio, resumed operations July 20 after a short shut-down. The Oil City Glass Bottle Company in July announced an expansion program to step up production 25 per cent. A new building, 50 by 136 feet, is under construction.

A contract said to be the largest ever placed for building glass was awarded to the Pittsburgh Plate Glass Company in July. It calls for more than one million square feet of flat glass of different types for the glazing of 28,000 windows, 10,000 doors and panels and office partitions in the ten buildings of the radio center now being planned. This enterprise is backed by the Rockefeller interests and the destruction of three blocks of old buildings, extending from 48th to 51st Streets between Fifth and Sixth Avenues, is well under way. Pittsburgh Plate Glass Company's Creighton Plant No. 2 resumed operations in August. About 1200 employees will work half time.

The Morgantown Glass Works, George Dougherty, president, resumed operations with accumulated orders, employing about 250 men, having been closed since June 19. The Seneca Glass Company has begun operation with 175 men at work. The resumption of operations by Mississippi factory and these two plants enabled several hundred men to secure jobs in that city.

C-B Buys Back Chapman Producer Division

On August 1, 1931, The Cooper-Bessemer Corporation purchased back the Chapman Gas Producer Division which was acquired in October, 1930, by The Surface Combustion Company of Toledo, Ohio. This involves no change in manufacture because Chapman gas producers and Chapman floating agitators have always been and will continue to be built in the shops of The Cooper-Bessemer Corporation, Mt. Vernon, Ohio.

Solvay's Fiftieth Anniversary

The Solvay Process Company of Syracuse, N. Y., which now supplies the world-wide market with alkalies in varied forms, will celebrate in September the fiftieth anniversary of its incorporation and also the establishment of the alkali industry on this continent.

Rowland Hazard, founder and first president of this company, acquired the American patent rights of Ernest and Alfred Solvay, perfectors of the method of manufacturing soda ash, which is now known as the Solvay Process.

The company, always in continuous operation, is believed to be the largest manufacturer of commercial alkali in this country with plants located at Syracuse, New York; Detroit, Michigan, and Hutchinson, Kansas. They also manufacture cleansing sodas, calcium chloride and liquid chlorine.

The Solvay Process Company completed the form of organization under which it operates today with the formation, in 1927, of the Solvay Sales Corporation which has entire control of the sale of Solvay products.

Eclipse Glass Company Fire

The buildings of the Eclipse Glass Company, Thomaston, Conn., were destroyed by fire on July 25, resulting in a temporary shutdown of Thomaston's only manufacturing plant to be running on full schedule throughout the period of the depression. This company, with Otto Vogt as sole proprietor, has filled more orders during the first six months of the current year than it filled during the entire year of 1930. Mr. Vogt has already gone ahead with the reconstruction of the plant and the Eclipse Glass Company will again be filling orders before long.

Imperial Glass Corporation

Early in August the committee in charge of raising money for the reorganization of the Imperial Glass plant at Bellaire, Ohio, reported a successful outcome. Among those who responded to the final appeal were a number of the old workers in the plant who subscribed to or increased their subscriptions for stock.

Earl D. Newton, of Chicago, has been elected president of the Corporation, a new organization which on August 8 elected directors and officers as follows:

William Siddall, vice-president; J. Ralph Boyd, secretary and treasurer; James W. Stewart, Charles H. Koch, C. L. Dorer, Henry Moore, Lee Paul, G. T. Gilmore, L. V. MacLain.

Toledo Banks Close

Many glass manufacturing concerns and individuals connected with the industry have been affected by the financial crisis in Toledo, Ohio. The Ohio Savings Bank and Trust Company and the Commercial Savings Bank and Trust Company have been closed. The American Bank controlled by the American Flint Glass Workers Union was also involved. Other smaller banks also shut their doors.

Glass Workers' Wage Contracts Renewed

At the conference held at Atlantic City late in July between the flint glass manufacturers and the American Flint Glass Workers Union it was agreed that no wage reductions shall be made in this branch of the industry during 1931. Increases in wages amounting to 10 per cent in certain branches have already become effective.

The bottle manufacturers' representatives also reached an agreement with the manufacturers' committee, J. Dale Dilworth, chairman, that all existing wage contracts in the bottle blowing industry should be renewed.

Tariff Investigations

The United States Tariff Commission will hold a hearing at Washington on October 1 on table and kitchen articles and utensils, wholly or in chief value of glass, blown or partly blown, regardless of composition, description or further treatment. This is the hearing originally set for May 14 but postponed.

The Commission has given notice that a hearing respecting feldspar will be held at the Tariff Commission's office in Washington, D. C., at 10 A. M., September 17, 1931, at which evidence will be received with regard to the differences in cost of production and all other facts and conditions ennumerated in section 336 of the Tariff Act of 1930 with respect to feldspar, crude and ground.

A similar hearing on gage glass tubes will be held at the Commission's Washington office at 10 a.m., September 29, 1931.

Laclede-Christy Absorbs Two Refractory Plants

The Laclede-Christy Clay Products Company of St. Louis, Mo., have purchased the assets of the Buckeye Clay Pot Company of Toledo, O., as well as those of the Walsh Clay Products Company of St. Louis. The general offices of the new corporation will be in St. Louis. The works of the Buckeye Company are to continue under the supervision of its present management, W. K. Brownlee, A. S. Zopfi and associates. The operations of the Walsh plant in St. Louis will be consolidated with the Laclede-Christy Clay Products Company at St. Louis.

Will Charge for Federal Specifications

The Federal Specifications Board has officially adopted recommended specifications TT-Z-301 Zinc-Oxide; Dry and Paste-in-Oil (Superseding USGMS 8), which became mandatory August 1, 1931, as far as applicable, upon all Government departments and independent establishments.

Multigraphed copies of Federal specifications hereafter officially adopted by the Federal Specifications Board will not be available in mimeograph or printed form for gratuitous distribution from this board. They must be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c. each, cash or money order.

July Production of Polished Plate Glass

The production of polished plate glass in the United States, compiled by P. A. Hughes, secretary of the Plate Glass Manufacturers of America, was for the month of July, 1931, 7,216,249 sq. ft., as compared to 7,554,219 sq. ft., produced in the preceding month, June, 1931, and 8,326,176 sq. ft. produced in the corresponding month last year, July, 1930.

The Standard Plate Glass Company's plant at Butler, Pa., may resume operations at an early date. The campaign to raise capital for this purpose has met with success, the total amount necessary having been pledged through subscriptions.

The Allegany Glass Corporation is the name of a new com-

pany for which an application has been made for incorporation in Delaware. A board of directors for the first year has been appointed. Officers will be elected at a subsequent meeting of the directors. The persons interested are the purchasers of the Mt. Jewett window glass plant which resumed operations early in August, having been closed since February.

The Mirror Manufacturers Association held their fall meeting at the Grove Park Inn, Asheville, N. C., on August 28th.

The Laminated Glass Manufacturing Company, Windsor, Ontario, Canada, has been sold to a company comprised of Ralph King of Toronto, the Hobbs Manufacturing Company, Ltd., and H. E. Allen of Windsor, formerly vice-president of the Libbey-Owens Sheet Glass Company, Toledo, O. Mr. King will be president of the new company. Under the new organization the company will extend its activities in the manufacture and distribution of laminated glass.

E. G. Bridges, vice-president and chief engineer of the Lynch Corporation, Anderson, Ind., sailed on August 19 on the *Leviathan* for a several months' trip to England and France. The primary reason for this visit is to supervise the installation of the Lynch Model 10 machine in several glass factories in these countries.

Mid-West Glass, Ltd., is the new name of the former Mid-West Glass Company, Ltd., of Winnipeg, Canada. Officers recently elected are: W. H. Carter, president; W. E. Blodgett, vice-president; C. Y. Chappel, secretary, and M. A. Yingling, general manager. The company specializes in glass containers.

The Olean Glass Company, Olean, N. Y., is modernizing its plant by the installation of automatic conveyors, lehr loaders, etc. H. L. Dixon Company, Pittsburgh, are already at work on the job.

The Superior Glass and Specialty Company of Cameron, W. Va., has been incorporated with a capital of $25,000. It was stated by Albert Fisher, general manager, that they recently took over the Eureka Glass Company at Cameron. Incorporators are: L. J. Manes, B. Manes, W. A. Rector, G. Usher and Harry Powell.

The Chicago Specialties Corporation under an Indiana charter will occupy a factory building on State Road 6, in Hobart, just east of Gary, Ind. The arrangements were completed through the Industrial Committee of Gary Commercial Club and Chamber of Commerce. The plant will produce glass novelties, lamp fixtures, gear shift knobs, figure lighters, and other types of goods. Distribution of these products has been arranged for through the Eagle Electric Manufacturing Company of Brooklyn, N. Y., a large organization. The company, it is said, will take in several glass experts. C. P. Askew, the superintendent, is said to have had a large experience in the novelty line.

The First Bohemian Glass Corporation, according to its director, A. O. Corbin, made a gross profit during 1930 of 18,268,829 Czecho crowns and net earnings of 2,252,518 crowns. The balance for 1929 was 630,072 crowns. A 15 per cent dividend as in 1929 was declared. The company during 1930 obtained an interest in Hungarian window glass companies and also in the erection of another one in Jugoslavia. The first Austrian Machine Glass Industry, a subsidiary, reported profits of 1,676,329 Austrian schillings in 1930, with net earnings of 261,967 schillings in 1930. The balance of this company was 18,276 schillings. It proposes to pay a 10 per cent dividend as in 1929.

The American Refractories Institute at a meeting recently held in St. Louis elected the following officers: President, W. B. Coullie, general sales manager, Harbison-Walker Refractories Company, Pittsburgh, Pa.; first vice-president, W. J. Westphalen, vice-president and general manager, Laclede-Christy Clay Products Company, St. Louis, Mo.; second vice-president, A. P. Taylor, president, the Chas. Taylor Sons Company, Cincinnati, O.; treasurer, C. C. Edmunds, treasurer, McLain Fire Brick Company, Pittsburgh, Pa.; secretary, Miss Dorothy A. Texter, Pittsburgh, Pa. Directors elected were George A. Balz, J. E. Lewis, John R. Sproul, A. P. Green, J. D. Ramsay, H. L. Tredennick, J. H. Cavender, A. P. Taylor, S. M. Kier.

Industrial Publications

Wilson-Maeulen Company, Inc., 385 Concord Avenue, New York, have issued new loose-leaf catalog pages, S 1-4 and N 5-8 inclusive. These sheets include standard chart ranges, record charts, recorders, tapalog supplies, etc.

Recent Deaths

Albert J. Rowling

Albert J. Rowling, connected with the recently reorganized Superior Glass Company, Cameron, W. Va., died suddenly last month in Uhricheville, Ohio, while traveling with Albert Fisher of the same company from Akron, Ohio, to Cameron. His widow and two children survive.

Coming Meetings

Glass Division of the American Ceramic Society Summer Meeting. Baltimore, Md., leave pier 10, Light Street, by Old Bay Line boat 6:30 P.M., Friday, September 11, for Old Point Comfort. Dinner on boat. L. C. Roche, Baltimore, chairman; A. N. Finn, A. K. Lyle, Jr., committee in charge.

National Glass Distributors Association, Eastern Division, will meet September 23, 24 and 25 at the Hotel Traymore, Atlantic City, N. J. **The Western Division** will hold their meeting on September 9, 10 and 11th.

The Illuminating Engineers Society's 25th annual convention (celebrating its silver anniversary), Pittsburgh, Pa., October 13-16 inclusive, headquarters, William Penn Hotel.

Inquiries Received

For further information address THE GLASS INDUSTRY.

559. Who makes the glassware called "Rubanite."

560. I wish to get in touch with a few establishments in New York who make bottles which are used for hair oil and perfume.

561. Where can we obtain in large quantities amber glass circles 2 15/16 inches outside diameter with an animal face etched on the bottom surface, for use in ash trays. We want an article possessing distinctive character but it must be cheap.

What the World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C. For further information write the department.

Canada—53029. Glass, wire, standard.

Costa Rica—53108. Glassware, especially bottles.

England—53187. Glass drinkers for bird cages.

Guatemala—53190. Glass for mirrors, windows, and picture frames, and plate glass.

Spain—53148. Glassware.

England—53164. Glassware, including table tumblers, jugs, bowls, glasses, candlesticks, trinket sets, and sugar and cream bowls.

Domestic—53283. Glassware.

Readers Wants and Offers

Address answers to all "keyed" ads c/o The GLASS INDUSTRY, 24 West 40th St., New York

SITUATION WANTED

Glass technologist of widely recognized ability. Seventeen years experience with prominent glass manufacturing concerns in research, control and development work. Mail replies to Box S-3 at the address given above.

WANTED: Glass carving machinery. We are in the market for used glass carving equipment at the right price. Mail replies to Box S-2, THE GLASS INDUSTRY, at above address.

CAPABLE EXECUTIVE WANTED

If you are at present not engaged in a position as executive and would consider a responsible position we will be pleased to receive a letter setting forth your experience pertaining to the manufacture and sales distribution of polished plate glass. Mail replies to Box S-1 at address given above.

Current Prices of Glass-Making Materials

August 21, 1931

Quotations furnished by various producers, manufacturers and dealers

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.35	.35
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.30½
Alconol, denatured	gal.	..	..
Aluminum hydrate (Al $(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.15½
Ammonia water (NH_4OH) 26° drums	lb.		
Antimony, metallic (Sb)	lb.	.02½	.02¾
Antimony oxide (Sb_2O_3)	lb.	..	.09¾
Antimony sulphide (Sb_2S_3)	lb.	..	.08½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.14 .04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05¼
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	..	.07¼
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.026-.03	..
Powdered	lb.	.02875-.03375	..
Boric acid (H_3BO_3)	lb.	.0625-.07125	.0625-.08125
Refined	lb.	.0625-.07125	.07125-.08125
Cadmium sulphide (CdS)—			
Red	lb.	..	.65-.90
Orange	lb.	..	.60-1.10
Yellow	lb.	..	1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	.23	.24
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	1.35-1.45
In 10 lb. tins	lb.	..	1.45
Copper oxide			
Red (Cu_2O)	lb.	..	.25
Black (CuO)	lb.	..	.17-.19
Black prepared	lb.	..	.22
Cryolite ($Na_3Al\ F_6$) Natural Greenland Kryolith)	lb.	.09	.09¼
Synthetic (Artificial)	lb.		.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb		..	1.15-1.20
*Feldspar—			
100 mesh	ton	11.50-17.50	12.00-18.00
80 mesh	ton	11.00-11.50	13.00
40 mesh	ton	10.75-11.00	12.00
20 mesh	ton	9.50- 9.75	10.00
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2 2½%)			
Bulk, carloads, f.o.b. mines	ton	30.00	..
In bags or barrels	ton	34.00	39.00
Imported	ton	30.00-31.00	33.00-37.00
Formaldehyde	lb	..	.07
Graphite (C)	lb	..	04-.0
Iron oxide—			
Red (Fe_2O_3)	lb	..	.0425
Black (FeO)	lb	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)		Carlots	Less Carlots
Lead chromate ($PbCrO_4$)	lb	..	30
Lead oxide (Pb_3O_4) (red lead)	lb	.069	.07¾
Litharge (PbO)	lb.	.059	.06¾
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	7.00	7.00
Burnt (CaO) ground, in bulk	ton	6.00	..
Burnt, ground, in paper sacks	ton	8.00	8.00
Burnt, ground, in 280 lb. bbls. Per bbl.		2.15	..
Limestone ($CaCO_3$)		1.75-2.50	1.75-2.50
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.10
Manganese 85% (MnO_2)	lb.	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¼
Ground	lb.	.11	.12
Potassium carbonate—94-96%	lb.	.0555	.0555
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07¼
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.25
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.06½-.06¾
Potassium permanganate ($KMnO_4$)	lb.	.16	.17
Powdered blue	lb.	..	.18
Rochelle salts, bbls.	lb.	..	.19
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.80
Silver nitrate (AgNO.)	(100 oz.) per oz.	..	.22½
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.07½	..
In barrels	Per 100 lb.	1.38	1.90-2.00
In bags	Per 100 lb.	1.17½	1.72½
Spot orders.. .025 per 100 lbs. higher		..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03¾	.04½
95 per cent	Per 100 lb	2.01½-2.05	2.06½-2.10
Sodium selenite (Na_2SeO_3)	lb	..	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04	.04½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50-1.55
Sulphur (S)—			
Flowers, in bbls	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls	Per 100 lb	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.37½	.39
Tin oxide (SnO_2) in bbls.	lb.	.28	.29½
Uranium oxide (UO_2) (black, 96% U_3O_8)			
100 lb. lots. Black	lb.	..	2.75
Yellow	lb.		1.50
Zinc oxide (ZnO)	lb.	.08½	.12
American process. Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude. Gran (Milled .005-.02c higher)		.03½	.04-.05

*Spot Shipments.

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to July 24, 1931.

	June 1930 Quantity	June 1930 Value	June 1931 Quantity	June 1931 Value	Five Months Ending June 1930 Quantity	Five Months Ending June 1930 Value	Five Months Ending June 1931 Quantity	Five Months Ending June 1931 Value
Glass and glass products (Total)	.....	$757,223	.....	$563,517	.....	$4,783,022	.....	$3,998,263
Plate and window glass—								
Window glass, common, box 50 sq. ft.	1,968	8,493	297	1,995	10,161	54,447	4,697	29,633
Plate glass, unsilvered, sq. ft.	302,103	75,642	260,680	81,947	1,790,607	541,099	2,248,781	691,086
Other window and plate glass lbs.	351,289	37,633	168,006	16,135	2,612,287	249,078	1,707,531	183,818
Glass containers (bottles, vials and jars)	.....	267,495	.....	157,976	.....	1,506,572	.....	1,115,226
Table glassware, plain	.....	92,779	.....	55,243	.....	641,546	.....	488,094
Table and other glassware, cut or engraved	.....	7,263	.....	6,111	.....	49,622	.....	45,386
Lamp chimneys and lantern globes lbs.	.....	24,796	.....	9,214	.....	121,202	.....	54,985
Globes and shades for lighting fixtures lbs.	.....	55,948	.....	34,549	.....	328,518	.....	234,368
Chemical glassware lbs.	25,138	21,067	12,869	11,689	120,284	112,560	76,512	76,256
Electrical glassware, except for lighting lbs.	318,377	18,151	295,641	14,947	2,680,217	173,620	903,746	58,953
Other glassware	.....	147,956	.....	173,711	.....	1,004,758	.....	1,020,458

IMPORTS

Corrected to July 24, 1931.

Glass and glass products	.....	$600,024	.....	$476,563	.....	$4,618,014	.....	$3,005,179
Cylinder, crown, and sheet—								
Plain dut. lb.	752,493	29,175	531,587	17,141	10,812,850	423,995	4,423,395	169,873
Bent, beveled, colored, etc. dut. lb.	.....	24,301	189,448	21,915	.....	199,590	1,065,170	139,296
Plate glass dut. sq. ft.	136,152	26,602	543,053	89,492	2,684,456	557,373	2,711,750	739,731
Glass mirrors	80,125	22,571	134	227	503,364	141,083	810	1,884
Rolled, cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc.	.....	2,302	.....	2,588	.....	2,302	.....	29,448
Laminated glass and manufactures, and plated glass	.....	1,987	.....	9,174	.....	1,987	.....	13,256
Bottles, vials, jars, and other containers	.....	76,562	.....	32,047	.....	699,387	.....	247,164
Scientific articles and utensils dut.	.....	47,989	.....	37,552	.....	298,198	.....	198,774
Tubes and rods dut.	.....	3,424	.....	12,580	.....	3,424	.....	60,790
Illuminating articles dut.	.....	41,243	.....	32,613	.....	326,759	.....	188,508
Blown glass articles—								
Bulbs for electric lamps, without filament dut.	.....	.....	1,117,873	9,176	.....	.....	7,237,431	69,061
Other blown glass articles dut.	.....	214,704	.....	119,097	.....	1,327,655	.....	652,660
Pressed glass articles	.....	12,975	.....	8,397	.....	83,100	.....	59,345
Other glassware	.....	96,189	.....	84,564	.....	553,161	.....	435,389